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BULLETIN
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A Revision of the North American Species of *Ophioglossum*.

(PLATES 318-319.)

BY ELIZABETH G. BRITTON.

The Fourth of July excursion of the Torrey Botanical Club in company with the Philadelphia Botanical Club and the Washington botanists, took place at Wildwood, New Jersey, a flourishing seaside colony about 12 miles from Cape May. On the afternoon of the 3d, Mr. Joseph Crawford, in company with Mr. Pollard, and Dr. Valery Havard, found a patch of *Ophioglossum*, between Holly Beach and Wildwood, growing in open woods under holly and oak trees (*Q. nana* and *Q. falcata*), in sandy soil where the grass had been cut. This single colony was the only one found in the region, and contained hundreds of plants, all in mature condition and beginning to turn yellow, thus making the patch a conspicuous object. All of us who had seen *O. vulgatum* growing, felt positive that this was not that species nor any other with which we were familiar. I was delegated to describe and name it and decided to call it, from its habitat, *O. arenarium*. I sent a specimen to Prof. Underwood, then at Kew, for comparison; after consulting with Mr. Baker, it was decided that it belonged to the section with *O. lusitanicum*, which has a similar gregarious habit, but differs in its much smaller size and narrower frond.

Prof. Underwood has called my attention to a monograph of the genus by Prantl (Jarhb. d. K. Bot. Gart. Berlin, 3: 297-350. 1884), in which two new North American species are described, thus far not included in our text-books, *O. Engelmanni* and *O. Cal-*

iformicum. These are perfectly distinct, and *O. Engelmanni* has a wide range, having been found in all the larger herbaria, such as those of Torrey and Gray, Eaton and Underwood, Canby and Gilbert, Engelmann and the National Herbarium. *O. Californicum* has thus far been seen only from the type locality at San Diego, California, where it was originally discovered in 1850, and specimens sent to Dr. Torrey by Dr. Parry, and from two other stations.

Through the kindness of Dr. Evans, Dr. Robinson, Dr. Rusby Prof. Underwood, Mr. Pollard, Mr. Davenport and Prof. Trelease I have been able to see a large number of specimens of this genus and have been particularly interested in studying the variations of *O. vulgatum*. Seven different forms of the sterile lamina can be named as follows: 1. Ovate-amplexicul, acute. 2. Ovate-sessile, obtuse. 3. Oval and elliptical, acute and obtuse. 4. Oblanceolate or obovate with tapering base. 5. Lanceolate and smaller. 6. Rotundate (immature). 7. Linear-lanceolate, occasional.

It seems a little difficult to tell some of the young fronds of *O. vulgatum* from the mature ones of *O. arenarium*, and yet the extremes are so different, and the habit and habitat so distinct, that I have concluded to maintain them as separate species. That *O. arenarium* has originated from *O. vulgatum*, and that intermediate forms may be found in young or poorly developed forms of *O. vulgatum* does not alter the view from the modern standpoint of evolution.

Young and immature specimens of what have been supposed to be *O. vulgatum* have been collected by a number of American botanists. In the Torrey Herbarium, unnamed, there is a sheet with six small immature specimens, two bearing fertile spikes and the following note by Dr. Gray:

Ophioglossum n. sp. I send you $\frac{1}{2}$ I have and probably shall not be able to procure any more very soon. 15 or 20 specimens were found on a dry hill at Exeter (Otsego Co.) 12 of them in fruit. A few specimens are in the hands of a friend who first noticed it, Dr. Hadley has a specimen and I sent some to Beck 2 years ago (the same summer it was discovered). He has never given an opinion or said a word about it. I do not know that *O. vulgatum* or any other species has been found in this section. It appears to come near *O. pusillum* Nutt. but that species has "frond cordate acute"—this has the frond *acute at the base* and

obtuse at the extremity. These specimens are as large as any that have been found.

If you think it new suppose you publish it. A. G.

Dr. Robinson sent for comparison from the Gray Herbarium the remainder of this same collection. They agreed perfectly with Dr. Torrey's in their immature condition and are labeled by Dr. Gray.

"Depauperate *O. vulgatum*, Exeter, Otsego Co. Dr. Curtiss." Inside the packet are two labels; one reads in Dr. Gray's handwriting.

"*Ophioglossum*. Can it be *O. vulgatum*? I am informed it is constantly of this size."

The other reads "It looks different, but still may be small var. of *O. vulgatum*. It would be desirable to see more specimens."

In searching Dr. Gray's letters I find in his autobiography an account of his early botanizing and collecting from 1828-1830, and that he speaks of showing plants that puzzled him to Dr. Hadley, and of beginning a correspondence with Lewis C. Beck, of Albany, and Dr. Torrey. While at Utica he spent one summer vacation collecting "down the Unadilla to Pennsylvania." The Unadilla is one of the northern tributaries of the Susquehanna, and forms the western boundary of Otsego County, where these ferns were collected by Dr. Curtiss. From the letters it would seem to have been about 1830. None of these specimens are more than 7 cm. high, the petioles 3-5 cm., the blades 2-3 cm. long by 5-10 mm. wide, lanceolate or oval, and the fertile spike is still so undeveloped that it is not more than half the length of the blade, and nearly sessile. Only two specimens at all like these have been seen from Europe, and they were found in Dr. Gray's and Prof. Eaton's herbaria, collected by Blytt at Christiania, Norway, and are labelled *O. vulgatum*. Some of them resemble the young sterile fronds of *O. arenarium*, especially those which do not bear any fertile spikes, yet the probability is that they are immature *O. vulgatum*, as similar specimens have been collected in May and June by Stewart H. Burnham at Vaughns, N. Y., and Alvah A. Eaton at Seabrook, N. H.

In the Herbarium of William H. Leggett, there were two sets of specimens collected by Mrs. Lucy A. Millington and a letter from her dated from Glens Falls, October 17, 1873, in which she says:

"I have always wished to botanize in North Elba on the sand plains and along their swamps. The sand is nearly white in some places and curiously enough there are heavy forests of deciduous trees there as well as some of larch and stunted Balsams. I enclose all the specimens of *Ophioglossum* I happen to have at present. The smallest are very poor ones, for which you may blame our growing village which runs streets into the very hiding places of our shyest plants, *Mitella nuda*, *Antigramma*, and this small fern nestling in the grass. I might, perhaps, have given you better ones. There is one more form of it which I wished you to see with the rest, where the frond is thick and clumsily shaped as if unfinished. It seems to lack the delicacy and grace of other ferns in a remarkable degree. The North Elba specimen is the first *Ophioglossum* I ever saw and I found but two. The specimens from Glens Falls are poor, as the ground having been constantly travelled over in consequence of a street being opened."

The small, immature specimen from North Elba has a broad oval frond, 2 cm. long by 1 cm. wide, and agrees with the broadest of the small ones collected by Dr. Gray. The specimens from Glens Falls are five in number; the tallest of them is 11 cm. in height with a fertile spike and pedicel 7 cm. long, and they resemble fruiting specimens of *O. arenarium*. She also sent Mr. Leggett a large specimen of *O. vulgatum* from Elizabethtown, N. Y., and she says she has found it more common than she expected.

Various intermediate stages of young *O. vulgatum* have been found in the collections examined. One of these dwarfed specimens was collected by Prof. Eaton at Brattleboro, Vermont; it is mounted with seven others, grading up in size to the normal form. Mr. Canby had one small specimen collected at Gilmanton, New Hampshire, by Joseph Blake, and two others from Norway, Maine, collected by S. I. Smith, which are much smaller than normal. Prof. Engelmann had specimens collected by E. Durand at Bethlehem, Pennsylvania, in 1853, with small lanceolate fronds, most of the plants, however, were immature; and Mr. Newlin Williams has collected in low damp woods with *Habenaria lacera*, at Solebury, Bucks Co., Pa., two specimens which are taller and larger than *O. arenarium*, but have the lanceolate leaves and narrow venation of that species. Prof. Macoun has collected on Prince Edward Island, in wet pastures near the sea, four small leathery specimens, which approach *O. arenarium* in size and shape, but five

others from the same locality show them to be *O. vulgatum*. Prof. Underwood has collected at Baldwinsville, N. Y., a set of young specimens of *O. vulgatum*, on June 14, 1890, part of which he pressed and the rest he cultivated in the laboratory until they matured. The smallest ones, with the shortest petioles and pedicels, had the blade almost round, like those of Dr. Gray and Mrs. Millington. He also has specimens from White Lake, Jamesville, New York, and West Goshen, Connecticut, which might well be taken for *O. arenarium*, but at the latter station he found all the intermediate forms which connect with *O. vulgatum*. In fact, his herbarium is rich in uncommon and intergrading forms of this species. I have seen one set of small European specimens which are intermediate between *O. vulgatum* and *O. arenarium*, and these were collected near Venice by Rigo, and have small ovate-lanceolate blades, and none of them exceed 14 cm. in height.

Mr. Willard N. Clute called my attention to the notes in the Linnaean Fern Bulletin, and told me that at the time that *O. vulgatum* was distributed to the members of the Fern Chapter, he had been struck by the great variation in the size of this fern. I wrote to Mr. Stewart H. Burnham, of Vaughns, N. Y., who kindly sent me a very interesting series of variations, the youngest of which, collected in May, 1896, are the exact counterpart of Dr. Gray's small specimens from Exeter. He also collected on July 7th, in a limestone pasture, small double specimens very closely approaching the Italian specimens collected by Rigo. Other specimens from the edge of the swamp and from beech woods are the large elliptical and oblanceolate forms of *O. vulgatum*. One of them is remarkable for the extreme elongation of the fertile spike beyond the sporangia.

One of the most marked characteristics of *O. arenarium*, aside from its habitat, is its habit of growing with usually two fronds from the same rootstock. This has also been observed in specimens of what appear to be *O. vulgatum*, though, in four out of seven cases noted, the blades of the sterile frond, whether bearing fertile spikes or not, are much reduced in size and venation, becoming either short or oval, as in Chapman's specimens from Florida, and Canby's from Pennsylvania, or else bearing one normal frond and another much narrower. Prof. Eaton, however, had

one double plant from Brattleboro, Vermont, with two large normal fronds, and Austin collected similar specimens at Closter, New Jersey. Prof. Macoun, however, found two and three fronds together on grassy banks at Hastings, which are quite unlike *O. vulgatum*, and yet are larger than *O. arenarium*.

All these variations suggested an inquiry as to what might be considered typical *O. vulgatum*. The description in Gray's manual reads: "Sterile frond (in the N. American form) obovate or ovate with a tapering sessile base and mostly borne below the middle of the stalk of the fertile spike." The figures given in the Manual show a large ovate-lanceolate sterile frond, 6 cm. long by 3 cm. wide. Very few American specimens have been seen which agreed with this figure, but they have been collected by Alvah A. Eaton in New Hampshire, Alfred Commons in Delaware, McCulloch in New Brunswick and Austin in New Jersey. The commonest form throughout the Northern and Eastern states, however, is like the figure given by Prof. Eaton in his Ferns of North America, which he describes as "sterile segment fleshy, sessile near the middle of the plant, ovate or elliptical, one to three inches long." His figure shows an oblanceolate frond, blunt at apex and tapering to a long narrow base. Elliptical fronds also are common, and the figure given in the Linnaean Fern Bulletin for October, 1896, fairly represents a common American variation. None of the oblanceolate fronds have been seen from Europe, though shorter and broader oval fronds occur on both continents, as well as the longer elliptical ones; a broad, blunt and distinctly ovate form is also common to both. Linnaeus describes the frond as ovate and cites Plumier's figures, which, unfortunately, I have not been able to see. The common European form, however, seems to be more acute and ovate-lanceolate, with an amplexicaul base, and is, therefore, often carinate; in American specimens it is very rare to find a leaf that is keeled owing to the tapering flat base. Specimens seen from England, France, Germany, Hungary and Switzerland are all broadest just above the base, and taper to an acute apex.

The venation varies according to the size and shape of the frond; in the ovate and oval forms the short marginal areolae, each with a single short, free veinlet, are more numerous; in the

elongated elliptical or oblanceolate forms the long narrow central areolae without any free veinlets, are more numerous. The immature and smallest fronds are more fleshy and the venation less distinct, the areolae much smaller, with seldom any free veinlets. In some fronds there is rarely a distinct or continuous midvein, somewhat stronger than those on either side, but in most fronds the central part of the leaf is marked by the extremely elongated and approximate narrow areolae.

In size Prof. Eaton says they vary "from two to twelve inches." Two inches would only include such very young forms as those collected by Dr. Curtiss at Exeter and Blytt's from Christiania. The usual size varies from 6-16 inches and the relative length of the stalk above and below the leaf also varies, the younger ones being longer below; for, as the plant matures, the fertile spike elongates and often exceeds the common petiole below the leaf. In *O. arenarium* it is 2-3 times longer, the petiole being quite short and immersed; this is true also of the small European specimens in the Gray Herbarium collected near Venice by Rigo, and of Macoun's multiple specimens from Hastings.

Prantl admits that the spores vary in size and the number of meshes, the largest specimens bearing the largest spores with the greatest number of meshes, but he says he has found similar spores on smaller double specimens. I have not found any American spores having as few areolae (6-12) as he describes in *O. vulgatum*; ours often have as many as 25-30 areolae on one surface of the spore, and the outline appears as a series of indentations rather than a papillose surface, as seen in the European specimens. I have found that in *O. arenarium* the surface is marked by irregular warty protuberances, almost all traces of the polygonal areolae of *O. vulgatum* being lost, and the surface less regularly pitted like a thimble as it is in *O. vulgatum*. I have also seen small forms of *O. vulgatum* approaching *O. arenarium* which had the spores like the former.

O. vulgatum has a wide geographical range, having been collected at various stations in Europe, and also showing much variation according to Prantl. It has been found in Western Asia; Prantl has not credited it to Japan, but there is a specimen in the Gray Herbarium collected in 1891 in Japan, which certainly

resembles the smaller, ovate-lanceolate forms of Europe. Prof. Eaton gives the range as follows: "Canada and New England to Texas and Arizona, also Unalaska, Europe, Asia, Madeira and the Azores." All the specimens from Texas and Arizona thus far seen have been found to be *O. Engelmanni*. I have not seen any of the Madeira specimens which Prantl describes as smaller, and approaching *O. lusitanicum*. The Azores specimens sent to me by Prof. Trelease and listed by him as *O. vulgatum polyphyllum* (8th Rept. Mo. Bot. Gard., 175. t. 64) have been variously recognized as a good species under the names of *O. polyphyllum* and *O. Azoricum*. They resemble our *O. pusillum* and are certainly quite as distinct. *O. vulgatum* has been collected in four Canadian stations by Macoun and Dawson; it is common in New England, and becomes rarer southward, through New York, New Jersey, Pennsylvania and Maryland, overlapping the range of *O. Engelmanni* in Virginia, Tennessee, Kentucky and Indiana. Several smaller, ovate forms have been collected in Louisiana and Florida by Hale and LeConte, and Blasdale has collected what appears to be this species in California. The specimens from Unalaska are either some unknown Asiatic species, or a new species of the *O. reticulatum* group, in which I here describe them as *O. Alaskanum*.

In habitat the North American stations vary from open woods, dry pastures, worn out mowing fields to boggy places with *Arethusa* and *Pogonia ophioglossoides*. In dry pastures it is stunted, in wet grassy places it is larger and less rigid. It is likely that most of the stations recorded in the Fern Bulletin by Miss Price from Kentucky, in dry open cedar woods belong to *O. Engelmanni*, as do all those from sterile and rocky hillsides in the Central and Southwestern States.

Prantl, in his monograph, recognizes 29 species, of which 8 have thus far been found in the United States; 27 of these are in the *Euophioglossum* section with entire sterile fronds, and all our species except *O. palmatum* of Florida belong to this section. The following key has been modified and adapted from his to include only the North American species:

I. EUOPHIOGLOSSUM.—Sterile frond simple, fertile spike 1.

PARANEURA.—Sterile frond with several equal parallel veins at base, midvein seldom if at all branched, though generally anastomosing with the lateral veins by short oblique veinlets, often disappearing below the apex.

- A. *Vulgata*.—Frond large, ovate to elliptic, basal veins 9–13.
 Apex obtuse; areolae narrow with few veinlets. 1. *O. vulgatum*.
 Apex mucronate; areolae broad with many veinlets. 2. *O. Engelmanni*.
- B. *Lusitanica*.—Frond small, lanceolate; basal veins 3–7.
 Plants 5–18 cm. high; peduncle 5–9 cm.; veins 7. 3. *O. arenarium*.
 Plants 2–6 cm. high; peduncle 5–15 mm.; veins 3. 4. *O. Californicum*.
 PTILONEURA.—Sterile frond with few or several unequal veins at base, midvein branching and generally continuous to apex.
- C. *Reticulata*.—Rootstock not thickened; plants 10–30 cm. high.
 Sterile lamina ovate or cuneate at base, thin. 5. *O. Alaskanum*.
 Sterile lamina reniform or cordate at base. 6. *O. reticulatum*.
- D. *Macrorhiza*.—Rootstock thick or globose; plants 3–8 cm. high.
 Peduncle from base of the cuneate lanceolate sterile lamina; rootstock tuberous. 7. *O. pusillum*.
 Peduncle from petiole; sterile lamina cordate; rootstock globose. 8. *O. crotalophoroides*.
 9. *O. palmatum*.
- II. CHEIROGLOSSA.—Sterile frond palmately divided, fertile spikes 5–14.

I. OPHIOGLOSSUM VULGATUM L. Sp. Pl. 2: 1518. 1753. Eaton,
 Ferns of N. Am. 2: 261. t. 81. figs. 1–3. 1880. Gray's Manual,
 6th Edition t. 20. 1889.

Plants 1–4 dm. high; rootstock cylindric, sometimes quite large and tuberous, bearing 1–3 leaves; petiole partly subterranean, 3–16 cm. long; sterile lamina ovate or ovate-lanceolate, oval or elliptic, most frequently oblanceolate or spatulate, 3–12 cm. long, 1–5 cm. broad; base long and narrow, tapering into the petiole, rarely broad and clasping; apex obtuse or acute, not cuspidate; basal veins 9–11, midvein sometimes slightly stronger, lateral veins approximate and parallel, connected by short oblique veinlets, forming long narrow areolae in the middle of the leaf, and shorter hexagonal ones near the margin and apex with usually one short straight free veinlet; epidermis fleshy and wrinkled in young plants, becoming pellucid when old, with numerous stomata; peduncle arising from the base of the sterile lamina, 10–30 cm. high; spike 1.5–5 cm. long, apex prolonged beyond the sporangia which are in 11–52 pairs; spores .03–.05 mm., reticulated with angular areolae, the ridges between narrow and thickened, making an irregular outline.

Preferring loamy soil in woods or open meadows, occasionally in boggy places or dry hillsides; usually a few scattered plants are found in one locality. Ranging from Quebec and Ontario, south to Florida; also in California. Widely distributed in Europe, Madeira and the Azores and Western Asia, and Japan.

2. OPHIOGLOSSUM ENGELMANNI Prantl.

O. vulgatum Eaton, Ferns of the Southwest, U. S. Geol. Surv. 340. 1878.

O. Engelmanni Prantl, Jahrb. d. K. Bot. Gart. Berlin, 3: 318. pl. 8. fig. 17. 1884.

Plants 8–22 cm. high; rootstock cylindric with long brown roots, often bearing 2–3 fruiting and 1 sterile leaf on the same plant with the sheathing base of the old leaves frequently persistent; petiole subterranean or partly exerted, 4–10 cm. long; sterile leaf elliptic or lanceolate-elliptic, obtuse but sharply apiculate, 3–9 cm. long, 1.5–5 cm. broad; fleshy, becoming pellucid when old and dry, slightly paler beneath; basal veins 13 or more, median one slightly stronger and unbranched below the middle of the frond, forking and anastomosing with the lateral ones above; lateral inner veins parallel and approximate, outer ones arcuate-erect; transverse veinlets oblique and large, forming broad oblong-hexagonal areas with numerous anastomosing or free veinlets included; cells of the epidermis flexuous, much elongated in the middle beneath, stomata numerous; peduncle starting from the petiole or the base of the sterile lamina, 3–9 cm. long; spike 1.5–2.5 cm. long, apiculate, sporangia 12–27 pairs; spores .045–.050 mm. in diameter, areolae 15–20, angular, striae not elevated.

Easily distinguished from *O. vulgatum* by the apiculate sterile frond, its broad areolae with numerous anastomosing veinlets and its shorter peduncle. Type locality in damp sterile places in the higher valleys at Comanche Spring, Texas, Lindheimer, May, 1849, no. 53. Also common on stony prairies, but very rare there with spikes; on rocks, in cedar woods near New Braunfels, Texas, Lindheimer, May, 1850, 414. It was distributed as *O. vulgatum* var. in E. Hall's *Plantae Texanae*, from low grounds Houston, April 16, 1871, no. 858. It had first been collected on arid rocks near the Mississippi at Jefferson Barracks, Missouri, by Riehl, May, 1841, 242; Allenton, Mo., G. W. Letterman, June, 1875; Springfield, Mo., E. M. Sheperd, 1879; Rocky hillsides, Eggert, May 31, 1887; Independence, B. F. Bush, May, 1894; 813–822; Calcareous soil, Natchitoches, Louisiana, April, Dr. Hale; wet and shady ground, 4500 ft. alt. Sanoita Valley, Arizona, Dr. Rothrock; on lime rocks, Tanner's Canyon, Huachuca mountains, Arizona, J. G. Lemmon, August 29, 1882; damp places on mesas around Mustang moun-

tains, Arizona, C. G. Pringle, September 13, 1884. It was also distributed as *O. vulgatum mucronatum* by G. D. Butler, in 1875, from Indian Territory below the Arkansas and Red River and is abundant at the highest elevations of the Sierra de San Francisquito, Lower California, T. S. Brandegee, October 18, 1890; on the flat top of a limestone ledge in northwest Arkansas, April, 1880, F. L. Harvey; moist spot in the cedar glades at Lavigne, Tennessee, A. Gattinger, May 16, 1882; dry open woods and cedar groves, Bowling Green, Kentucky, Sadie F. Price. An unusually large and deformed specimen was collected by Prof. Underwood on the campus of Indiana University at Bloomington, Indiana, June, 1893, and W. Alphonso Murrill has collected it this year at Staunton, Virginia.

3. OPHIOGLOSSUM ARENARIUM n. sp.

Plants 5–18 cm. high, rootstock slightly thickened, bearing 1 or often 2 fertile plants and large fleshy roots; petiole 1–4 cm. long partially or rarely entirely subterranean; sterile lamina 2–5 cm. long, 5–12 mm. wide, lanceolate with a long tapering base, apex obtuse, rarely acute or apiculate, fleshy becoming wrinkled when dry, not pellucid; basal veins 5–7, the median straighter and distinct almost to apex, the lateral more or less parallel and connected by short oblique veinlets, forming long narrow areolae in the centre of the leaf with a few faint free or anastomosing veinlets, and much shorter irregular areolae toward the margin; epidermal cells sinuous, stomata numerous; peduncle arising from the base of the sterile lamina, 5–9 cm. long; spike 1–3 cm. long, often twisted, apiculate with 12–26 pairs of sporangia; spores .04–.05 mm. in diameter, reticulations indistinct or completely obliterated in the ripe spore by numerous minute irregular thickenings, forming a warty surface.

Gregarious in a single colony of hundreds of plants, forming a patch five feet in diameter, of a yellow color when mature, growing not far from the beach, under oaks, cedar and holly in sandy soil at Holly Beach, New Jersey, July 3, 1897, discovered by Joseph Crawford and Charles L. Pollard.

4. OPHIOGLOSSUM CALIFORNICUM Prantl.

O. vulgatum Cleveland, Bull. Torr. Club, 9: 55. 1882.

O. Californicum Prantl, Jahrb. d. K. Bot. Gart. Berl. 3: 315. *pl. 7. fig. 11.* 1884.

O. nudicaule L. fide Davenport, Bull. Torr. Bot. Club, 9: 71. 1882.

Plants small, only 2–6 cm. high; rootstock cylindric, tuberous, elongated with numerous large roots; leaves 1–2, sheathed at base by the old ones of the previous year; petioles entirely subterranean, 1–2 cm. long; sterile lamina 1–2 cm. long; .4–.7 mm. wide, lanceolate or ovate-acute, rarely obtuse, or apiculate; fleshy, rugose when dry; basal veins 3, median the stronger, lateral ones branched; transverse veinlets oblique, forming long narrow areolae with few or no free veinlets near the margin; epidermis wrinkled, cells flexuous, stomata straight; peduncle arising from the base of the sterile lamina, only 5–15 mm. long; spike 5–10 mm. long; sporangia 10–15 pairs, apex short; spores .05 mm. reticulate, areolae 20–25, rounded, striae unequal, not elevated.

In grassy, stony spots upon the high mesa near San Diego, California, Cleveland and Parry, March and April, 1882; also Mesas near San Diego, C. R. Orcutt, no. 212, March 25, 1882. Moist mesas, Lower California, April 10, 1882, C. G. Pringle; near Enemada, Mexico, April 10, 1882, M. E. Jones.

In the herbarium of D. C. Eaton there is a specimen collected by D. Cleveland, ex Herb. George E. Davenport which is labelled *O. nudicaule*, "Rediscovered by Dr. C. C. Parry in March, 1882, after a lapse of thirty-two years. A specimen in the Torrey Herbarium labelled simply "*Ophioglossum* Dr. Parry," is evidently one of the original collection, as Dr. Torrey was not living in 1882, and his specimens differ from the later collections in age and condition. Prof. Eaton had one of Dr. Parry's 1882 specimens, which is very interesting, as the sterile frond is bleached and thin, showing the venation perfectly, and the fertile spike is foliaceous and flattened, also bleached and thin, showing the veins and the cells from which the sporangia originate, with a flat, apical prolongation and immature spores, each with three ridges, radiating like spokes, as figured for other species by D. C. Eaton.

5. OPHIOGLOSSUM ALASKANUM n. sp.

O. vulgatum Eaton, Ferns of N. Am. 2: 261. 1880. ex. p.

Plants 6–12 cm. high; rootstock not seen; petiole subterranean in part, 2–8 cm. long; sterile lamina 2.5–6 cm. long, 2–3.5 cm. wide, ovate or ovate-lanceolate, suddenly dilated above the cuneate clasping base; apex obtuse or acute, not apiculate; frond thin or slightly fleshy, venation distinct; basal veins 9–11, midvein slightly

stronger at base, distinct to apex, usually giving off 1-4 branches; lateral veins divergent from the base, forming regular hexagonal areolae, connected by short oblique veinlets, including several free or anastomosing veinlets; peduncle arising from petiole at the base of the sterile lamina, 3-9 cm. long; spike 5-20 mm. long, apiculate, sporangia 8-21 pairs, spores .027-.035 mm, trivittate, with irregular broken areolae, giving the surface a warty appearance; striae not elevated.

On hillsides in rather well-drained situations, Unalaska Id. Alaska, L. M. Turner, 1878. Distributed as *O. vulgatum* by George E. Davenport from the Massachusetts Horticultural Society, ex herb. J. Schneck. Mr. Davenport has recently sent us some fine specimens showing considerable variation in size and shape, stating that he had long been intending to re-examine this species, as he felt that it was intermediate between *O. vulgatum* and *O. reticulatum*, and that his specimens are marked "probably *O. reticulatum*." They differ from *O. vulgatum* in the branching midvein and divergent lateral veins as well as in the larger areolae with more numerous included veinlets; from *O. reticulatum*, which has not been reported north of Mexico, in the shape of the sterile frond, which is neither cordate nor reniform. Mr. Baker writes from Kew that he cannot separate the Unalaska plant in any way from *O. vulgatum* and that he looks on *O. pedunculatum* as a mere variety of that species. I cannot agree with him in either of these opinions.

6. OPHIOGLOSSUM PUSILLUM Nutt. Gen. : 248. 1818.

O. nudicaule Sturm in Mart. Fl. Bras. fasc. 23. 144. In part, not L.

O. tenerum Mett. fide Prantl. l. c. 322. t. 8. fig. 23. 1884.

Plants 2-9 cm. high; rootstock short, slightly thickened, bearing 2-7 fronds; petiole very short, 5-15 mm. long, subterranean; sterile lamina small, 5-15 mm. long, 5-9 mm. broad, cuneate-lanceolate or ovate, acute or acuminate, rarely broadest at the base; basal veins 3, midvein distinct to apex, branching by lateral veinlets which form narrow areolae with no free veinlets; epidermis wrinkled when dry, stomata numerous; peduncle arising from the base of the sterile lamina, 2-6 cm. long; spikes 5-10 mm. apiculate, sporangia 6-14 pairs; spores .030-.032 mm., 3-ridged, slightly and indistinctly roughened.

Type locality in South Carolina, Nuttall; sandy hills near the Savannah River, Georgia, Beyrich; sandy pastures near Mobile. Alabama, Charles Mohr, October and November; Apalachicola

and Campbellton, Florida, Chapman; on damp sand along the margins of pine barren ponds, Levy Co., 1877, and near Rosewood, Florida, A. P. Garber, November, 1877; Ocean Springs, Mississippi, S. M. Tracy; New Orleans, Louisiana, Drummond, 1833.

A minute species ranging through the Southern and Gulf States to Mexico and Cuba, also in Guiana and Brazil, though many of the larger specimens in the herbarium of D. C. Eaton and probably at Kew, are referable to other tropical American species. A specimen in the herbarium of Prof. Underwood, collected in "Moist places in the Sierra Madre Mountains, Chihuahua, Mexico, by C. G. Pringle, Oct. 21-30, 1887," is certainly not this species. It is much larger and the venation is quite different. It is probably undescribed. There has been much confusion as to the proper name for this species. *O. nudicaule* L. belongs to an African species collected at the Cape of Good Hope by Thunberg, and Prantl enumerates five authors who have applied the name to seven different species, and concludes that our North American specimens should be known by a manuscript name *O. tenerum* of Mettenius. Eaton and other American authors have discarded *O. pusillum* Nutt., because he describes the frond as cordate. Some notes by J. H. Redfield in the Eaton Herbarium made from Nuttall's types at the Philadelphia Academy of Sciences, prove, however, that his specimens of *O. pusillum* are what we have been calling *O. nudicaule*, and he says that it is "scarcely ever more than an inch high." Besides he enumerated *O. bulbosum*, of which *O. pusillum* has been considered a synonym, as a distinct species.

7. OPHIOGLOSSUM CROTALOPHOROIDES Walt. Fl. Carol. 256. 1788.

O. bulbosum Michx. Fl. Bor. Am. 2: 276. 1803.

Plants 3-12 cm. high; rootstock globose, large, often 1 cm. in diameter, bearing few slender roots, and several fronds; petioles subterranean, 1-3 cm. high; sterile lamina 1-3 cm. long, .5-2 cm. broad, concave or carinate, broadly ovate and cordate at base, apex acute; basal veins 5, midvein slightly stronger, rarely branched and continuous nearly to apex; lateral veins freely anastomosing, forming short hexagonal areolae with no or rarely one free veinlet; peduncle slender, 1-9 cm. long, arising from the petiole; spike short, broad, 3-10 mm. long, apiculate; sporangia 4-11 pairs; spores .05 mm. diam., reticulate with raised ridges.

Carolina, Walter, l. c.; and "Bosc. Hb. Willd., no. 19422" fide Prantl; South Carolina, Michaux; Summerville, S. C., Constance G. DuBois, April, 1889; Fernandina, Florida, C. E. Faxon, 1873; Manatee, A. P. Garber, March, 1878; Apalachicola, Chapman, February, 1883; New Orleans, Louisiana, Drummond, 1832; Alexandria, Dr. J. Hale; Jackson, Dr. Ingalls, 1835; Mobile, Alabama, Chas. Mohr, 1844; Auburn, L. M. Underwood, March, 1896; Enterprise, Miss., S. M. Tracy, March, 1897; Houston, Texas, E. Hall, March, 1892. This species ranges south into Mexico, Caracas, Bolivia, Chile to Argentina, and has been credited to "Wet Pine barrens of New Jersey" ("Pursh"), in Barton's Flora N., of N. America, and Wood's Class-Book, though this is probably a mistake.

8. *OPHIOGLOSSUM PALMATUM* L. Sp. Pl. 1518. 1753; Eaton, Ferns of N. Am. 2: 269. t. 81. figs. 11-14.

Cheiroglossa palmata Presl. Suppl. 57. ?

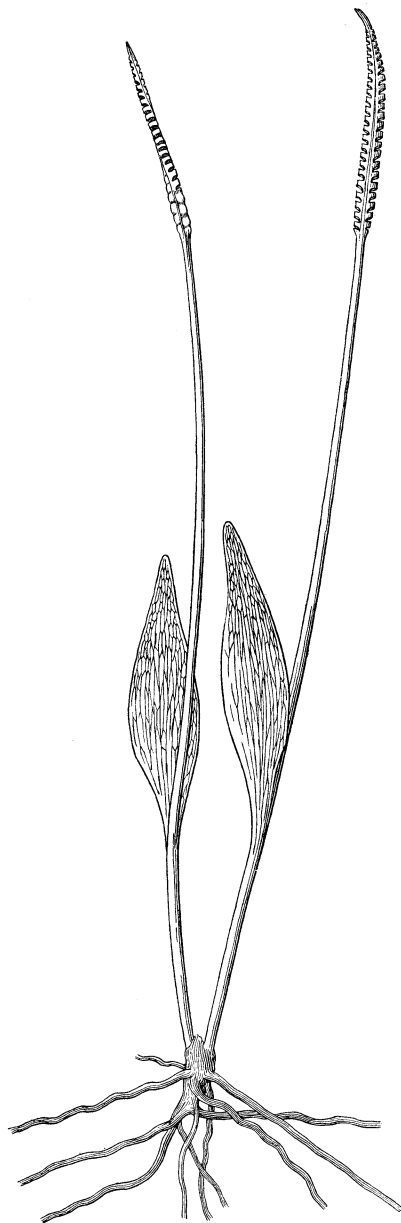
Plants 2-3 dm. high, bearing several fronds from a thick scaly rootstock; petiole 6-20 cm. long, blade 10-20 cm. long, usually palmately divided into 2-9 broadly spreading segments, rarely simple and lanceolate; basal veins 5-8, repeatedly branching and anastomosing, forming long hexagonal areolae without any free veinlets; peduncles arising from the petiole and the base of the sterile lamina, 1-16, short, 1-2 cm. spike 1-3 cm. long; sporangia 15-40; spores .06 mm., reticulations angular, striae slightly elevated.

A tropical species usually found on palms and palmettos in Florida, Caloosahatchee River, Chapman, 1875; hummocks of the Caloosa River, A. P. Garber, 1878; Indian River, Mary C. Reynolds, 1879; Chuckalaskee, E. W. Reasoner, 1887; Manatee, L. M. Underwood, 1891. Ranging through Mexico, and the West Indies, to Brazil.

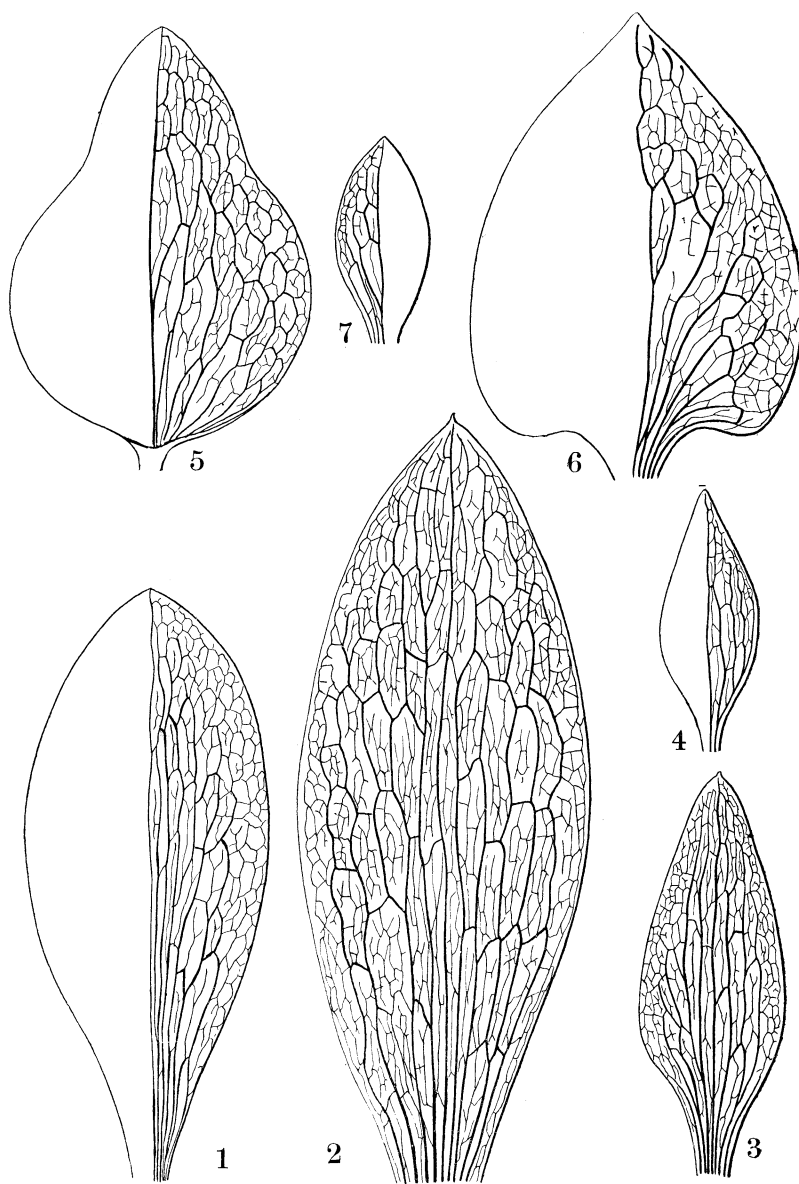
Description of Plates.

Plate 318. Drawn by Mr. Walpole under the supervision of C. L. Pollard. *Ophioglossum arenarium*, n. sp., E. G. Britton.

Plate 319. Drawn by F. Emil under the supervision of E. G. Britton. Venation of fronds in 1. *O. vulgatum*. 2. *O. Engelmanni*. 3. *O. arenarium*. 4. *O. Californicum*. 5. *O. Alaskanum*. 6. *O. reticulatum*. 7. *O. pusillum*.



OPHIOGLOSSUM ARENARIUM E. G. BRITTON.



VENATION OF OPHIOGLOSSUM.